

REMARKS

Claims 1-8 and 10-21 are pending in the application. Claims 1-6 are withdrawn from consideration as being directed to non-elected inventions. In the Final Office Action of August 10, 2004, the Examiner made the following disposition:

- A.) Rejected claims 7, 8, 10, 11, 16, and 19-21 under 35 U.S.C. §103(a) as being unpatentable over *Hayes* in view of *Hotchkiss* and *Behun*.
- B.) Rejected claims 12, 13, and 17 under 35 U.S.C. §103(a) as being unpatentable over *Hayes*, *Hotchkiss* and *Behun*, and further in view of *Nishikawa et al.* and *Denning et al.*
- C.) Rejected claims 14 and 15 under 35 U.S.C. §103(a) as being unpatentable over *Hayes*, *Hotchkiss*, *Behun*, *Nishikawa et al.* and *Denning et al.*, and further in view of *Okumura*.
- D.) Rejected claim 18 under 35 U.S.C. §103(a) as being unpatentable over *Hayes*, *Hotchkiss* and *Behun*, and further in view of *Jackson*.

Applicant respectfully traverses the rejections and addresses the Examiner's disposition as follows:

- A.) Rejection of claims 7, 8, 10, 11, 16, and 19-21 under 35 U.S.C. §103(a) as being unpatentable over *Hayes* in view of *Hotchkiss* and *Behun*:

Applicant respectfully disagrees with the rejection.

Referring to Applicant's Figures 1 and 5 for illustrative purposes, Applicant's independent claim 7, as amended, claims a method of producing a semiconductor apparatus in which metal ball bumps 116b are formed in direct contact with a circuit pattern 111 of a semiconductor device formed on a semiconductor substrate in a semiconductor wafer. A resin film 117 is formed on a circuit pattern forming surface of the semiconductor device so as to seal spaces between the metal ball bumps 116b and to become thinner than a height of the metal ball bumps 116b. The surfaces of the metal ball bumps 116b projecting out from the resin film 117 are cleaned. After the cleaning step, eutectic solder layers 118 different in composition from the metal ball bumps 116b are formed on the surfaces of the metal ball bumps 116b. At least one of the semiconductor chips is mounted on a mounting board 200 from a bump forming surface side of the semiconductor chip so as to connect the eutectic solder layers 118 of the semiconductor chip 110 to the mounting board 200 with the resin film 117 directly contacting the semiconductor chip 110 and not directly contacting the mounting board 200.

Thus, as shown in Applicant's Figure 5, the eutectic solder layers 118 are formed on the metal ball bumps 116b. As shown in Figure 1, the resin film 117 does not directly contact the

mounting board 200.

This is unlike *Hayes* in view of *Hotchkiss* and *Behun*. None of *Hayes*, *Hotchkiss* or *Behun*, taken singly or in combination, disclose or suggest metal ball bumps formed in direct contact with a circuit pattern, with eutectic solder layers formed on the surfaces of the metal ball bumps. As acknowledged by the Examiner, *Hayes* fails to disclose metal ball bumps formed in direct contact with a circuit pattern. (Office Action of 2/14/04, page 3). Instead, as stated by the Examiner, *Hayes* discloses solder columns 3 formed in direct contact with a circuit pattern. *Id.* *Hayes's* solder columns protrude from a dielectric layer 4 and metal ball bumps 9 are formed *on top of* its solder columns 9 and dielectric layer 4, with no eutectic solder layers formed on its metal ball bumps 9.

Hotchkiss discloses metal ball bumps 114 in direct contact with a circuit pattern, but with no eutectic solder layers formed thereon. *Behun* teaches forming metal ball bumps on LMP solder. Thus, none of the cited references, taken individually, teaches eutectic solder layers formed on metal ball bumps.

The Examiner argues that one having skill in the art allegedly would have been motivated to replace *Hayes's* solder columns with *Hotchkiss's* metal ball bumps to allegedly arrive at the claimed invention. The Examiner argues that both *Hayes's* solder columns and *Hotchkiss's* metal ball bumps provide a conductive path and, therefore, one skilled in the art would have been motivated by *Hayes* in view of *Hotchkiss* to interchange *Hayes's* solder columns with *Hotchkiss's* metal ball bumps. Applicants respectfully disagrees.

Hayes clearly states that it uses solder columns instead of solder ball bumps to avoid accidentally short-circuiting its underlying electrical pads (*Hayes*, col. 9, line 62 - col. 10, line 9). Therefore, *Hayes* specifically teaches away from forming metal ball bumps on its electrical pads, and teaches to instead use solder columns. Therefore, *Hayes* in view of *Hotchkiss* would not teach one skilled in the art to replace *Hayes's* solder columns with *Hotchkiss's* solder ball bumps, since *Hayes* clearly teaches away from using solder ball bumps instead of solder columns. Therefore, *Hayes* in view of *Hotchkiss* fails to disclose or suggest claim 7.

Further, *Hayes* teaches using solder columns 3 as conductive paths through its dielectric layer 4, so that *Hayes's* metal ball bumps 9 can be electrically coupled to the underlying chip via the solder columns 3. *Hayes's* solder columns 3 are formed to serve as narrow vias in *Hayes's* dielectric layer 4. This is unlike *Hotchkiss's* metal ball bumps 114, which serve to solder-connect one device to another device. Therefore, Applicant respectfully submits that *Hayes's* solder columns 3 do not serve the same purpose as *Hotchkiss's* metal ball bumps 114. *Hayes's* solder

columns 3 serve as vias, and *Hotchkiss's* metal ball bumps serve as direct solder-connects.

Nowhere do any of the cited references, taken singly or in combination, disclose or suggest forming eutectic solder layers on the surfaces of any metal ball bumps. *Hayes* discloses metal ball bumps 9 on its solder columns, but fails to disclose or suggest forming eutectic solder layers thereon. *Hotchkiss* discloses metal ball bumps 114 with no eutectic solder layers formed thereon. *Behun* discloses an LMP solder 16 having a HMP metal ball bump 18 formed thereon.

Therefore, unlike Applicant's claim 7, none of the cited references, taken alone or in combination, disclose or suggest a metal ball bump having a solder layer formed thereon. Accordingly, *Hayes* in view of *Hotchkiss* and *Behun* fails to disclose or suggest claim 7.

Claims 8, 10, 11, 16, and 19-21 depend directly or indirectly from claim 7 and are therefore allowable for at least the same reasons that claim 7 is allowable.

Applicant respectfully submits the rejection has been overcome and requests that it be withdrawn.

B.) Rejection of claims 12, 13, and 17 under 35 U.S.C. §103(a) as being unpatentable over *Hayes, Hotchkiss* and *Behun*, and further in view of *Nishikawa et al.* and *Denning et al.*:

Applicant respectfully disagrees with the rejection.

Applicant's independent claim 7 is allowable over *Hayes, Hotchkiss* and *Behun* as discussed above. *Nishikawa* and *Denning* still fail to disclose or suggest a metal ball bump having a eutectic solder layer formed thereon, with the eutectic solder layer mounted to a mounting board. Therefore, *Hayes, Hotchkiss* and *Behun*, and further in view of *Nishikawa* and *Denning* still fails to disclose or suggest Applicant's claim 7.

Claims 12, 13 and 17 depend directly or indirectly from claim 7 and are therefore allowable for at least the same reasons that claim 7 is allowable.

Applicant respectfully submits the rejection has been overcome and requests that it be withdrawn.

C.) Rejection of claims 14 and 15 under 35 U.S.C. §103(a) as being unpatentable over *Hayes, Hotchkiss, Behun, Nishikawa et al.* and *Denning et al.*, and further in view of *Okumura*:

Applicant respectfully disagrees with the rejection.

Applicant's independent claim 7 is allowable over *Hayes, Hotchkiss, Behun, Nishikawa*, and *Denning* as discussed above. *Okumura* still fail to disclose or suggest a metal ball bump having a eutectic solder layer formed thereon, with the eutectic solder layer mounted to a

mounting board. Therefore, *Hayes*, *Hotchkiss*, *Behun*, *Nishikawa*, and *Denning*, and further in view of *Okumura* still fails to disclose or suggest Applicant's claim 7.

Claims 14 and 15 depend directly or indirectly from claim 7 and are therefore allowable for at least the same reasons that claim 7 is allowable.

Applicant respectfully submits the rejection has been overcome and requests that it be withdrawn.

D.) Rejection of claim 18 under 35 U.S.C. §103(a) as being unpatentable over *Hayes*, *Hotchkiss* and *Behun*, and further in view of *Jackson*:

Applicant respectfully disagrees with the rejection.

Applicant's independent claim 7 is allowable over *Hayes*, *Hotchkiss* and *Behun* as discussed above. *Jackson* still fail to disclose or suggest a metal ball bump having a eutectic solder layer formed thereon, with the eutectic solder layer mounted to a mounting board. Therefore, *Hayes*, *Hotchkiss* and *Behun*, and further in view of *Jackson* still fails to disclose or suggest Applicant's claim 7.

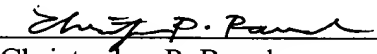
Claim 18 depends directly or indirectly from claim 7 and is therefore allowable for at least the same reasons that claim 7 is allowable.

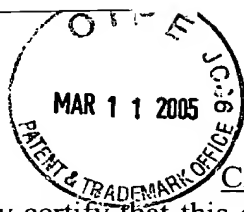
Applicant respectfully submits the rejection has been overcome and requests that it be withdrawn.

CONCLUSION

In view of the foregoing, it is submitted that claims 7-8 and 10-21 are patentable. It is therefore submitted that the application is in condition for allowance. Notice to that effect is respectfully requested.

Respectfully submitted,

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